dyestuffs ; but if exports were neglected, overheads would be extravagantly high. The highest export of British dyestuffs before the Second World War was in 1929, and only in that year and in 1937 (5,728 tons) were the figures for 1919 (5,446 tons) and 1920 (6,157 tons) exceeded. In nineteen years under the Dyestuffs Act, nothing was done to increase British exports of dyestuffs.

This, Dr. Levinstein suggested, had some bearing on the figures which caused Sir Henry Tizard concern. Moreover, there had been no further reduction in imports, which averaged 2,325 tons during 1919–26 (including the abnormally high figures for 1920, following the Sankey judgment) and also for 1927–38. The post-war period figures showed improvement. Exports increased to 12,148 tons in 1950 and 12,486 in 1951, and thus do not substantiate the claim that the German firms have recovered their lost ground. On the other hand, imports increased from 786 tons in 1950 to 1,657 tons in 1951, and of these last Dr. Levinstein noted that 676 tons came from Switzerland and 220 tons from the United States, as much being paid to these 'hard currency' countries as we paid to Germany in 1913. Dr. Levinstein also noted that there are now thirty-seven dyestuffs makers in Britain, and he concluded his survey by referring to the potentialities of the small firm and the possibility of formidable competition later from the U.S.S.R. in dyestuffs and in other chemicals.

FOOD PRODUCTS FROM PLANTS

THE Nutrition Panel of the Society of Chemical Industry, at the third of its series of meetings on "Food and the Future", held in the rooms of the Chemical Society, London, W.1, on March 25, discussed the subject of "Newer Sources of Foodstuffs". Two papers were under discussion : one by Dr. A. C. Thaysen, of the Colonial Microbiological Research Institute, Trinidad, on food and fodder yeast, and the other by Mr. N. W. Pirie, of the Rothamsted Experimental Station, on the efficient use of sunlight for food production.

Dr. Thaysen's paper pointed out that the process of making use of waste material as a medium for the growth of yeast is a measure of our shortage of food. The original idea for the use of yeast as a human food was for children in countries experiencing undernutrition where the need for supplementary protein is most acute. The value of yeast lies in its ability to convert about 80 per cent of the inorganic nitrogen supplied into protein. The rate of conversion, compared with more orthodox methods, is enormous : for example, a fully grown bullock, weighing half a ton, produces protein at the rate of 0·9 lb. per day ; half a ton of soya beans at the rate of 82 lb. per day ; and half a ton of *Torulopsis* could produce protein at the rate of 51 tons in 24 hr.

Food yeast is at present being produced both in Jamaica and in South Africa. The cost, at 1*s.* 2*d.* per lb., corresponds to 0·069*d.* per lb. of protein, compared with 0·8*d.* per lb. of protein from beef. However, very little yeast is at present consumed by man. In Germany and Finland it is used solely as animal feed, and, if the comparison is then made between yeast and other sources of animal feed, the economic aspect, at the present time, is unfavourable ; thus food yeast sells at £130 per long ton, compared with soya bean meal at £30. It is necessary to take into account the presence of an appreciable concentration of vitamins in the yeast. As a supplement to human dietaries, apart from its protein content, yeast would supply much-needed members of the vitamin B-complex and, used in this way, is certainly economical.

In the absence abroad of Dr. Thaysen, his paper was introduced by Mr. H. J. Bunker, who emphasized the future possibilities of food yeast, when present economics could be considered irrelevant. He pointed out that dried brewers' yeast sells at £90 per ton, and when debittered, but not extracted, at £130.

The value of *Torulopsis* as a food converter, compared with *Saccharomyces*, lies in its ability to ferment pentoses as well as hexoses. This is valid only when waste sulphite liquor is used as a medium ; when grown on molasses, both these organisms are equally valuable. Vast quantities of raw material are available : for example, as much as a quarter of a million tons of waste sulphite liquor, which really is a waste material, is available annually in the United States and Canada, as well as hydrolysed wood, banana skins, bracken and peat.

Rhodotorula gracilis could provide a valuable addition to fat resources, as the organism contains 42 per cent fat and 23 per cent protein. Earlier reports of the unpalatability of yeast, when it was said that only about 15 gm. per day could be consumed without causing digestive disorders, were probably due to contamination with defrothing agents. Well-prepared yeast is quite palatable.

Mr. Pirie said in his paper that at present we are entirely dependent upon sunlight for our food supplies ; but photosynthesis is extremely inefficient. Much of the light is reflected, absorbed by inactive surfaces or by surfaces which are rendered inactive because of unsuitable conditions. The advocates of unicellular photosynthetic organisms, such as *Chlorella*, dispute that farming is the best way to produce food. Algæ have, however, no greater efficiency in trapping sunlight, but can be more readily made to work at maximum efficiency by provision of optimum temperature, carbon dioxide and nutrients. These conditions would render *Chlorella* culture as costly as glasshouse cultivation. It was pointed out later in the discussion, however, that efficiencies up to 20 per cent have been achieved by growing *Chlorella* in the open, as compared with 2–3 per cent for ordinary crops. In addition, the plasticity of metabolism of the organism permits production of food material of any desired composition : for example, 60 per cent protein : 5 per cent fat or 10 per cent protein : 80 per cent fat.

As the green plant will be our main source of food for a long time to come, the best use must be made of it. Only a small part of the crop is eaten directly by man ; most is fed to animals or used as a fertilizer, or even wasted. Crops grown primarily as animal food are wasteful, despite the high esteem in which their products are held, because the overall conversion is usually only 5–10 per cent. Economies in the use of soil can be made both here and by replacing textile fibres by synthetic fibres.

The direct consumption of crops by man is desirable. Plants are, however, relatively poor sources of protein, with the exception of legume seeds and most young leaves. Young, vigorously growing leaves contain up to 30–40 per cent protein and little fibre ; but only a few plant species will stand up to continuous cropping of very young leaves. The alternative is to separate the fibre from the proteins, fats and carbohydrates of lower-quality leaves. The advantage of fractionating leafy crops lies in the fact that the products are more valuable when separated than when combined. The proteins are suitable for non-ruminants and perhaps man, the fluid extract could be used for feed or as a medium for micro-organisms, and the fibrous residue, still containing some proteins and starches, is suitable for ruminants or even for fuel.

In many parts of the world there are abundant leafy wastes, such as potato haulms, sugar-beet leaves and sweet potato leaves. When, however, satisfactory techniques have been developed, our choice of domesticated plants might well be reconsidered. Plants that use sunlight most efficiently might be chosen rather than those grown merely because a use has been found for them. On the question of economics, leaf protein, even extracted from crops grown specially for the purpose, would cost less than existing protein foods and about the same as estimates for yeast and *Chlorella*.

The discussion revealed two trends of thought on these new natural sources of foodstuffs. One was that orthodox agriculture would see us through this century and that these novel methods should await the development of new techniques. The other was that present drawbacks to these new foods are largely due to lack of information and that further investigation is most desirable. As Mr. Pirie said, all methods of increasing the world's food supply must be pushed ahead, for they are complementary rather than conflicting.

A. E. Bender

BRITISH GELATINE AND GLUE RESEARCH ASSOCIATION

ANNUAL REPORTS FOR 1951 AND 1952

The recently received third annual report of the council of the British Gelatine and Glue Research Association (pp. 13; 1951) covers the year October 1950–September 1951, and the fourth (pp. 19; 1952) for that ending in September 1952. The former report records an increase of two in the full membership but no change in the staff. Two meetings of the Research Panel were well attended, the second, a symposium on the uses of gelatine and glue, providing a valuable opportunity for interchange of views between manufacturers and users. It was decided that at future meetings, in addition to papers of the type previously presented, accounts would be given of the research work of the Association; and the visit to the laboratories, which is a regular feature of Panel meetings, has proved a valuable link between the Association's staff and that of member firms. The fourth annual report records two additions to associate membership and one to full membership, as well as the appointment of an additional research officer for work on the physical and mechanical properties of gelatine and glue. The laboratories were officially opened on November 29, 1951, by Sir Robert Duncalfe, and two further meetings of the Research Panel are reported (see *Nature*, **169**, 24 (1952); **170**, 24 (1952); and **171**, 250 (1953)).

The reports of the Director of Research, included with each of these annual reports, indicate that during the next two or three years a substantial body of new knowledge concerning gelatine and glue will have been built up. Work on the purification of gelatin by ion exchange resins, for example, has shown that the ash content of gelatin is reduced from 2–3 per cent to 0·005 per cent by passing a 5 per cent solution through a mixed bed of the 'Amberlite' resins *IR*120 and *IRA*400. Even very high arsenic contents can thus be reduced below the limit prescribed for edible gelatine, and the method provides a ready means of determining isoelectric points. Detailed studies of the viscosity of very dilute solutions of gelatin have shown that the gelatin molecule is in a partly folded configuration at its isoelectric point, the equal and opposite charges along the molecule contributing to the folding. The technique developed by F. Sanger, in which fluorodinitrobenzene reacts with free amino groups of proteins, has been applied to the determination of end-groups in gelatin, and studies have also been made of the organic constituents of bone, while new methods have been developed for estimating the colour and clarity of gelatine and glue solutions and gels and for the accurate determination of arsenic in gelatine. A device has been constructed to facilitate accurate testing of jelly 'strength', and a detailed investigation of sampling errors in bacterial counts on powdered gelatine indicates that the variation is related to irregular distribution of bacteria in the gelatine, probably originating from the drying operation.

WORLD-WIDE CHANGES IN THE PHASE OF THE COSMIC-RAY SOLAR DAILY VARIATION

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Measurements of the cosmic-ray diurnal variation at sea-level using directional counter arrays[1] have shown that the variation is at least in part due to an anisotropic distribution of the primary radiation entering the atmosphere. Since the variation is dependent on solar rather than sidereal time,

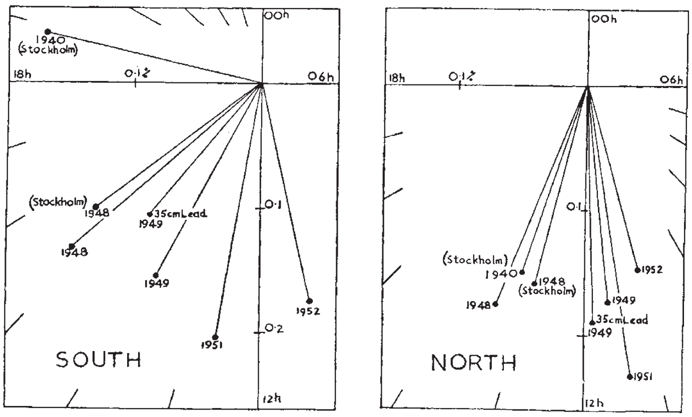

Fig. 1. Harmonic dials showing the first harmonics of the daily variation measured in Manchester and Stockholm using counter telescopes pointing south and north. All the measurements have been made using unshielded telescopes with the exception of one set of data for Manchester in 1949, when 35 cm. lead absorber was used